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Date of Deposit: September 6, 2006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Appln. of:	BRANDSTÄTTER et al.	
Appln. No.:	Not Yet Assigned	Examiner: Not Yet Assigned
Filed:	September 6, 2006	
For:	X-RAY APPARATUS AND MAMMOGRAPHIC X-RAY APPARATUS WITH AN INDICATOR	Group Art Unit: Not Yet Assigned
Attorney Docket No:	11371/135	Client No. (2004P04755WOUS)

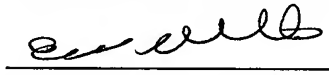
SUBMISSION OF SUBSTITUTE SPECIFICATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Please replace the specification as filed with the enclosed substitute specification-clean copy. The substitute specification includes no new matter and does not include any claims. Also enclosed is a marked-up copy of the substitute specification. The marked-up copy shows the changes made to add and delete matter in the specification. If for any reason, the Examiner believes further information or an additional change is required, she is respectfully requested to call the undersigned at (312) 321-4726.

Respectfully submitted,



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Our Case No.11371/135

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: X-RAY APPARATUS AND MAMMOGRAPHIC X-RAY APPARATUS WITH AN INDICATOR

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Substitute Specification – Clean Copy
WO 2005/110233 PCT/EP2005/052047

X-RAY APPARATUS AND MAMMOGRAPHIC X-RAY APPARATUS WITH AN INDICATOR

[0001] The present patent document is a continuation of PCT Application Serial Number PCT/EP2005/052047, filed May 4, 2005, designating the United States, which is hereby incorporated by reference. The present patent document also claims the benefit of foreign application number DE 10 2004 023 046.3 filed on May 11, 2004, which is hereby incorporated by reference.

BACKGROUND

Field

[0002] The present embodiments relate to an X-ray apparatus, such as a mammographic X-ray apparatus. The apparatus includes an indicator.

Related Art

[0003] Generally, mammographic X-ray apparatuses have an indicator. Before the actual process of taking the X-ray images, the indicator projects an exemplary trace of an X-ray field on the surface of a patient body and/or on an object table. The X-ray field is monitored, for example, to assure that the correct diaphragm has been chosen. Conventionally, an incandescent bulb mounted laterally of the X-ray beam path is used. The beam of light from the incandescent bulb that extends perpendicular to the X-ray beam path, is deflected into the direction of the X-ray beam by a mirror disposed in the X-ray beam path. During the actual taking of the X-ray image, the mirror is folded out of the way of the beam path, or if it is radiotransparent, it stays in the beam path.

[0004] An X-ray apparatus of this kind is known from German Patent Disclosure DE 199 43 898 A1. According to DE 199 43 898 A1, an indicator in the form of laser diodes have been previously used, for example, for X-ray apparatuses used as aids in surgery. The indicators are mounted either on the X-ray detector or on the X-ray source. Accordingly, the region through which the X-radiation passes, for

example, above the surface of the patient and/or the X-ray field on the surface of the patient, is visible (illuminated). The indicator is designed to be adaptable to the geometry of the X-ray beam, for example, the size of the opening angle, for instance by sending a signal for changing the aperture of the diaphragm onward to the indicator.

SUMMARY

[0005] The present embodiments relate to an X-ray apparatus and a mammographic X-ray apparatus with an indicator. The present embodiments may obviate one or more of the problems due to the limitations and disadvantages of the related art. For example, one exemplary embodiment illuminates the X-ray field, which precedes the actual making of the X-ray, in a way that is simple and involves little effort.

[0006] In one exemplary embodiment, an X-ray apparatus includes an X-ray beam generated by an X-ray source and a diaphragm. At least one LED is disposed as an indicator between the X-ray source and the diaphragm. The illuminating beam of the at least one LED is directed in an undeflected fashion onto the X-ray field, and the at least one LED is pivotable (swivable) out of the X-ray beam. The at least one LED is mounted on a filter array that is mounted between the X-ray source and the diaphragm. Accordingly, the diaphragm may not be used for shaping the beam of the X-ray beam and shaping the beam of the illuminating beam, and thus deflecting the illuminating beam can be eliminated. Complicated control of the orientation of the indicator means is eliminated, and a mirror that can be folded away is unnecessary, making a compact, low-maintenance construction possible.

[0007] In one exemplary embodiment, at least one LED is mounted on a filter array that is associated with the X-ray apparatus and is located between the X-ray source and the diaphragm. In most X-ray apparatuses (systems), the filter array is fundamentally present. All that is needed is a mount for the LED. Alternatively, the

LEDs are disposed on a common ring mount, in a way that is expedient for simple mounting if there is a plurality of LEDs surrounding the X-ray beam.

DRAWINGS

[0008] Figure 1 illustrates a side view of a known mammographic X-ray apparatus with an incandescent bulb and deflection mirror that illuminates an X-ray field;

[0009] Figure 2 illustrates a side view of a mammographic X-ray apparatus with a plurality of LEDs on a ring mount for illuminating the X-ray field according to an exemplary embodiment;

[0010] Figure 3 illustrates an exemplary ring mount;

[0011] Figure 4 illustrates a side view of a mammographic X-ray apparatus having at least one LED on a filter array for illuminating the X-ray field according to an exemplary embodiment;

[0012] Figure 5 illustrates a filter array with at least one LED according to one exemplary embodiment.

DETAILED DESCRIPTION

[0013] Figure 1 shows a mammographic X-ray apparatus 1 according to the prior art. The mammographic X-ray apparatus 1 includes both an X-ray source 5 and a detector, for example, an object table 2 equipped with an X-ray film. During an examination, the X-ray source 5 generates an X-ray beam 11 that projects an object (image) (not shown), of a patient, which is to be examined, onto the detector. The mammographic X-ray apparatus 1 includes a diaphragm 4 that limits the X-ray beam 11 by blanking out, collimating, or blocking some portions of the X-ray beam 11. Before an actual operation of making an X-ray image, an X-ray beam location on the surface of the patient or on the object table 2 is monitored by an illuminating beam 7 that is generated by an incandescent bulb 12. The illuminating beam 7 is deflected by a mirror 13 in the direction of the X-ray field. The incandescent bulb

12 and the mirror 13 are adjusted, so that the illuminating beam 7 and the X-ray beam 11 are substantially congruent on the surface of the patient or on the object table 12. In one exemplary embodiment, the mirror 13 is radiotransparent in order not to hinder the X-ray beam 11. Alternatively, the mirror 13 can be folded out of the way of the X-ray beam 11.

[0014] Figure 2 shows a different embodiment of a mammographic X-ray apparatus 1.1. The mammographic apparatus 1.1 includes a plurality of LEDs 6 disposed between an X-ray source 5.1 and a diaphragm 4.1. The illuminating beam 7.1 is directed onto the X-ray field. In one exemplary embodiment, the illuminating beam 7.1 is undeflected when directed onto the X-ray field. For example, the term "undeflected" does not preclude the use of lenses for correcting the illuminating beam within a range of up to 15°.

[0015] In one exemplary embodiment, the LEDs are disposed between the X-ray source 5.1 and the diaphragm 4.1. The illuminating beam 7.1 of the LEDs is limited by the diaphragm 4.1. The beam field of the illuminating beam 7.1 on the surface of the patient and/or on the object table 2.1 is substantially congruent with the X-ray field of the X-ray beam 11.1. The LEDs are disposed outside the X-ray beam 11.1. For example, the LEDs are distributed over the X-ray beam's 11.1 outer circumference. Both the X-ray beam and the LEDs are protected from damage from each other. According to one exemplary embodiment, the LEDs are disposed on a common ring mount 10.

[0016] Figure 3 illustrates a ring mount 10. The ring mount 10 includes individual LEDs 6. The X-ray source 5.1 and the X-ray beam 11.1 are shown in cross section at the level of the ring mount 10. As shown in Figure 3, the ring mount 10 is embodied and mounted in such a way that the X-ray beam 11.1 can pass through the center of the ring without being hindered. The ring mount 10 is on the X-ray source 5.1.

[0017] According to another exemplary embodiment, as shown in Figure 4, an X-ray apparatus 1.2 includes at least one LED 6.2 mounted on a filter array 3.Alternatively, a plurality of LEDs may also be mounted to increase the brightness. The filter array 3 is mounted between the X-ray source 5.2 and the diaphragm 4.2 and moves individual filters 8.1; 8.2; and 8.3 into the X-ray beam. The filters 8.1; 8.2; and 8.3 filter out frequencies not needed for the particular X-ray image to be made.

[0018] In one exemplary embodiment, the at least one LED 6.2 is positioned in the filter array 3. The at least one LED 6.2 can be used instead of a filter 8.1; 8.2; 8.3, and is pivotable (swivelable) out of the X-ray beam 11.2. When illuminating the X-ray field, the filter array 3 is pivoted (swiveled), so that the at least one LED 6.2 is located in the beam path of the X-ray beam 11.2. The illuminating beam 7.2 is substantially congruent with the X-ray beam 11.2. The at least one LED 6.2 may be pivotable (swivable) out of the X-ray beam 11.2 by rotation of the filter array 3 about its longitudinal axis. When the X-ray image is being made the required filters 8.1; 8.2; and 8.3 can be pivoted (swiveled) into the beam path.

[0019] Figure 5 illustrates a filter array 3. For example, the filter array 3 is used in the mammographic X-ray apparatus 1 shown in Figure 4. The filter array 3 includes four mounts for filters or LEDs. According to one exemplary embodiment, three individual filters 8.1; 8.2; and 8.3 are inserted into mounts, and at least one LED 6.2 is disposed in the other mount. The present embodiments are not limited to this arrangement. For example, any combination of filters and LEDs can be used in the filter array.

[0020] While the invention has been described above by reference to various embodiments, it should be understood that many changes and modifications can be made without departing from the scope of the invention. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents,

that are intended to define the spirit and scope of this invention.